BATTERY SWAPPING SYSTEM AND TECHNIQUES

CROSS-REFERENCE TO RELATED APPLICATION

[0001] The present U.S. Utility Patent Application claims priority pursuant to 35 U.S.C. §120 as a continuation of U.S. Utility application Ser. No. 14/694,995, entitled "BATTERY SWAPPING SYSTEM AND TECHNIQUES", filed Apr. 23, 2015, which claims priority pursuant to 35 U.S.C. §119(e) to U.S. Provisional Application No. 61/983,328, entitled "BATTERY SWAPPING SYSTEM AND TECHNIQUES", filed Apr. 23, 2014, both of which are hereby incorporated herein by reference in their entirety and made part of the present U.S. Utility Patent Application for all purposes.

BACKGROUND

[0002] Vehicles using sustainable energy sources, such as electricity, are becoming more prevalent as an alternative to combustion-engine vehicles. An electric or hybrid vehicle that has at least one electric traction motor typically has a battery pack or other enclosure that contains one or more electrochemical cells that provide propulsion energy for the motor or motors. Because the process of charging such cells usually takes some amount of time, some vehicles are designed so that the battery can be replaced with another battery, to replenish power in the vehicle or to address malfunction in the current battery.

BRIEF DESCRIPTION OF DRAWINGS

[0003] FIGS. **1-3** shows a layout of an example concept in respective front, side and top views.
[0004] FIG. **4** shows the system before a vehicle enters the station.
[0005] FIG. **5** shows that the vehicle is guided by rollers as it enters the station.
[0006] FIG. **6** shows that the vehicle creeps forward until it is correctly positioned in the X direction.
[0007] FIG. **7** shows that the vehicle is correctly positioned in the X direction, that the jack mode is enabled, and that vehicle power is turned off.
[0008] FIG. **8** shows that vehicle chocks can be used to control the position in X direction.
[0009] FIG. **9** shows that the vehicle rolls over horizontal doors while pulling in, and that steel tube guides on the doors can help align the vehicle in the Y direction.
[0010] FIG. **10** shows the tube guide on the door as the vehicle is pulling in.
[0011] FIG. **11** is a view from below and shows door supports, and a tube under the door.
[0012] FIG. **12** shows that the process of raising the vehicle is beginning.
[0013] FIG. **13** shows that the inboard lifts are starting the process of raising the vehicle to a predetermined height (in this example, about 65 inches).
[0014] FIGS. **14-15** show that the vehicle has been lifted to the predetermined height.
[0015] FIG. **16** shows that lifting arms of the inboard lifts can engage jack pads (or any other suitable lifting points) on the vehicle.
[0016] FIG. **17** shows that the system is ready to open the floor doors.
[0017] FIG. **18** shows that the doors have been opened.
[0018] FIG. **19** shows that the system is ready to raise the battery lift (here, the outboard lift).
[0019] FIGS. **20-22** show that the battery lift has been raised until it touches the underside of the battery pack, so as to support the battery pack for removal.
[0020] FIG. **23** shows that the battery lift can have ball transfer pads supporting the battery.
[0021] FIG. **24** shows that after the battery lift is correctly positioned to support the battery pack, fastener removal can begin.
[0022] FIG. **25** shows that a battery conveyor shuttle is brought underneath the vehicle.
[0023] FIG. **26** shows that the system is ready to lower the battery (on the battery lift) onto the conveyor shuttle.
[0024] FIG. **27** shows that the battery lift with the battery has been lowered.
[0025] FIG. **28** shows that the system is ready to move the used battery away from the vehicle and bring in a fresh one.
[0026] FIG. **29** shows that the used battery is being removed on the conveyor shuttle.
[0027] FIG. **30** shows that the fresh battery has been brought underneath the vehicle on a conveyor shuttle.
[0028] FIG. **31** shows that the system is ready to raise the fresh battery into the vehicle.
[0029] FIG. **32** shows that the fresh battery has been raised into contact with the vehicle.
[0030] FIG. **33** shows that the system is ready to return the conveyor shuttle to the staged position.
[0031] FIG. **34** shows that the shuttle is being so returned.
[0032] FIG. **35** shows that the fresh battery is being supported by the ball transfer pads.
[0033] FIG. **36** shows that the battery pack fasteners (e.g., bolts) are fastened (e.g., torqued to specifications).
[0034] FIG. **37** shows that the system is ready to lower the battery lift.
[0035] FIG. **38** shows that the battery lift has been lowered.
[0036] FIG. **39** shows that the system is ready to close the battery lift doors.
[0037] FIG. **40** shows that the battery lift doors have been closed.
[0038] FIG. **41** shows that the system is ready to lower the vehicle lift.
[0039] FIG. **42** shows that the vehicle lift has been lowered.
[0040] FIG. **43** shows that after having been lowered, the vehicle can turn on its power and the status of various systems in the vehicle can be confirmed (e.g., a 12V system and a high-voltage system).
[0041] FIG. **44** shows the state of the system after a swap has been completed and before the next vehicle enters, which can be serviced using the same or a similar procedure.
[0042] FIG. **45** shows that the station can have an entrance door, a vehicle lift mechanism inside the building, and an exit door.
[0043] FIG. **46** shows that a forklift can be used to raise and lower the battery pack.
[0044] FIG. **47** shows that a moving device for battery packs can be positioned on rails in order to move between battery storage and the serviced vehicle.

DETAILED DESCRIPTION

[0045] This document describes systems and techniques for swapping an electrical energy storage system, such as a